

CLINICAL OBSERVATIONS ON THE PATHOGENESIS
OF TUBERCULOSIS: FROM A 15 YEAR FOLLOW-UP
OF 745 NURSES.

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The pathogenesis of tuberculosis has for many years been thought of in terms of primary or "childhood type" tuberculosis and reinfection or "adult type", tending to be differentiated each into its own rather characteristic clinical and prognostic pattern. Tuberculin and x-ray surveys of children and young adults the past twenty years have conditioned our thinking in terms of tuberculin negative and positive reactors, again each with its own type of lesion: primary or "childhood type" tuberculosis occurring in those initially negative reactors who turn positive, and reinfection or "adult type" tuberculosis that occurs in those already positive. Still further has been a prevailing view that "primary" tuberculosis is a relatively benign disease compared to that of "reinfection" type.

Ghon¹ and Ranke² first wrote of "primary" tuberculosis as a "childhood" disease and "reinfection" as its "adult" form. Epidemicological changes in the morbidity and mortality of tuberculosis have altered our attitude towards these earlier concepts, because large sections of the population now do not develop their first or "primary" infection until the second, third or fourth decades of life.

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It is the purpose of this study to present the clinical observations of a long-term follow-up study of tuberculosis in nurses with some discussion of the subject of so-called "primary" and "reinfection" tuberculosis in young adults. The execution of this study of the pathogenesis of tuberculosis as seen in our nurses presents nothing new. Similar work was initiated in this country by Amberson and Riggins,³ Geer,⁴ Shipman and Davis,⁵ Myers⁶ and, in Norway, Heimbeck,⁷ before ours was begun in 1932 at the Boston City Hospital. A five to fifteen year follow-up of 745 nurses admitted as regular students to our training school is the basis of this report. The discussion will pertain to the clinical course, treatment, and prognosis of the seventy-one cases of tuberculosis that developed in the tuberculin negative and positive reactors on admission.

INCIDENCE OF TUBERCULOSIS.

It is of interest in the first place that the tuberculin negative and positive reactors were almost equally divided on admission (Table I).

TABLE I.

INITIAL TUBERCULIN TEST IN 745 NURSES.

Total nurses studied: 1932-1948	745 (100 %)
Total tuberculin negative on entry.....	362 (48.6%)
Total tuberculin positive on entry.....	374 (50.2%)
Initially unknown	9 (1.2%)

Secondly, while somewhat more tuberculosis appeared in the initially negative reactors over fifteen years, there was no significant difference in the total amount of disease appearing in the two groups. (Table II).

TABLE II.

TUBERCULOSIS IN 745 NURSES.

	<i>No.</i>	<i>Per Cent</i>
Total tuberculosis in 745 nurses.....	71	9.5
Tbc in 362 initially negative reactors.....	40	11.0
Tbc in 374 initially positive reactors.....	31	8.2
Tbc in 9 unknown reactors.....	0	0.0

Fifty-two, or fourteen per cent of negative reactors remained negative throughout training. Therefore, if one studies the total amount of tuberculosis in the initially positive reactors compared with what appeared in those who *converted* from "negative" to a "positive" tuberculin test, there is more tuberculosis in the group who "*converted*". (See Table III).

TABLE III.
TUBERCULOSIS IN "NEGATIVE" REACTORS.

	No.	Per Cent
362 Negatives, total tuberculosis	40	11.0
285 Negatives, converted to positive.....	40	14.0
52 Negative through training	2	3.8
25 Unknown course	0	0.0

The 71 cases of tuberculosis include one case of cervical lymphatic disease proved by biopsy, 65 cases of pulmonary tuberculosis and 5 cases of pleurisy with effusion without demonstrable parenchymal

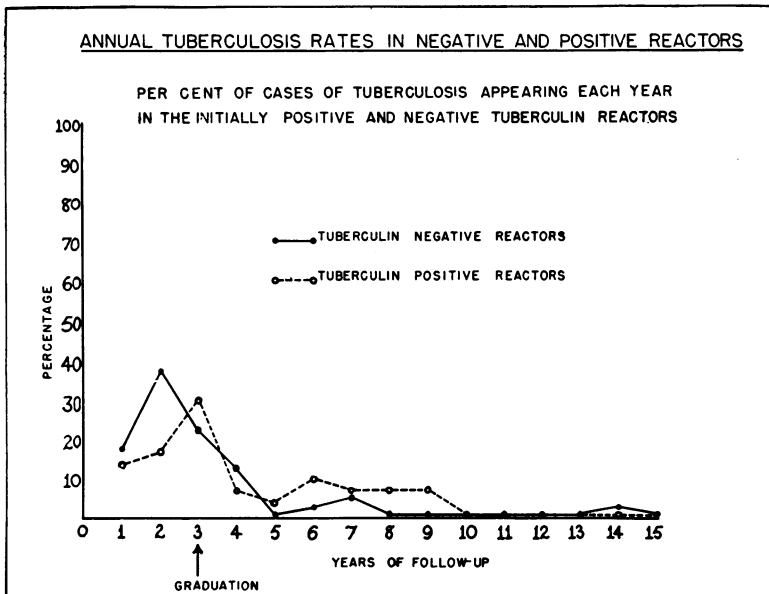


CHART I.

disease. Hereafter, tuberculosis that appears in "negative" or "initially negative" reactors implies that the "negative" tuberculin test has turned positive.

Thirdly, there was a closely parallel course in the rates at which tuberculosis appeared each year after entrance into training in the two groups of tuberculin reactors. (See Chart I).

If, however, the tuberculosis of the negative reactors on admission is analyzed and its appearance in years from date of entry is compared with its appearance in years following date of "conversion" from tuberculin negative to positive, a different picture is presented. (See Chart II).

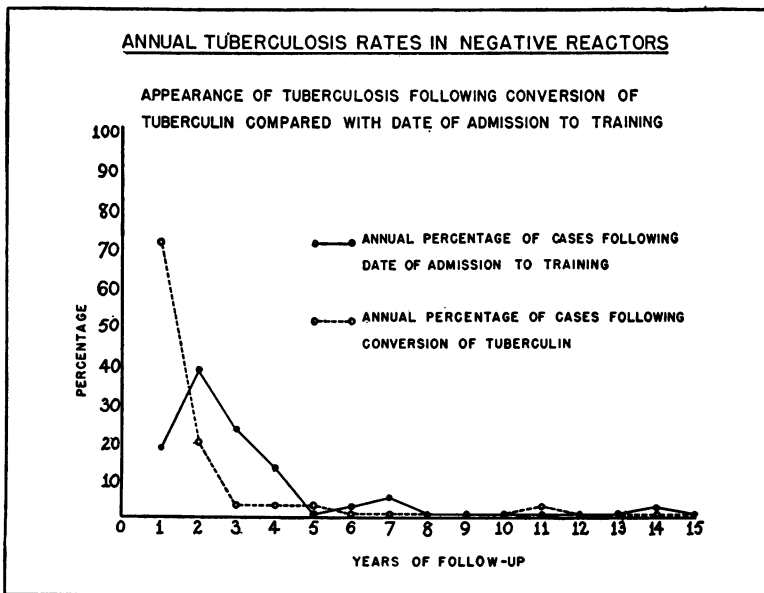


CHART II.

Thus two years following admission to training the initially negative reactors developed 55 per cent of their tuberculosis, but two years following tuberculin conversion to positive 85 per cent of the disease had appeared in the same group. Positive reactors

in the same two year period developed only 32 per cent of their tuberculosis. After the five year period following admission to training the negatives on admission showed 90 per cent and the positives 70.5 per cent of their disease. Once again the passage of time levels the early differences in incidence of tuberculosis between the two groups.

Fifty-two individuals in this series (or 14.3 per cent of all negative reactors), remained negative throughout the three year training period with a constantly high degree of exposure to the tubercle bacillus from open pulmonary tuberculosis on the wards. Their late tuberculin conversion rate is not known but it *is* known that, over the fifteen year study period, only two cases of tuberculosis have so far appeared in those nurses who remained tuberculin negative through training; a rate of 3.8 per cent, which is the lowest of any group. (Compare Tables II and III).

THE CHARACTER OF TUBERCULOSIS IN INITIALLY TUBERCULIN NEGATIVE AND POSITIVE REACTORS.

The case histories that follow are a sampling to demonstrate only a few of the similarities and differences that existed in the tuberculosis that developed in the two groups of tuberculin reactors.

Case I.

M.H.C.

PROGRESSIVE MINIMAL DISEASE AT BED REST IN AN INITIALLY NEGATIVE REACTOR.

This 18 year old, very blond young nurse was admitted to training with a negative tuberculin test in September, 1932. July, 1934, her tuberculin test was first positive, at the time that a fever of undetermined origin appeared along with small-joint pain, but no redness. She was hospitalized at that time, July, 1934, remained at bed rest and was studied thoroughly for the cause of her low-grade fever with the final thought that it was rheumatic. Discharged home in December, 1934 after five months of bed rest, she returned to duty in January, 1935, feeling well.

A week after starting work, she fainted on the ward, was hospitalized again, and was found to have fever to 100 and some recurrence of joint pains. Therefore, still being thought rheumatic, she was transferred to a hospital for rheumatic fever. Here she was symptom free for a few weeks, then showed

a slowly rising temperature. Three months after admission she had cough and sputum. X-rays showed extensive infiltration of the left upper lobe and a sputum containing many tubercle bacilli.

Reviewing her plates, she showed in July 1934, a small area of infiltration, 1 cm. in diameter in the periphery of the third left anterior interspace, not seen during her hospital admission. In January of 1935 when she returned to work, there was in addition a gland in the right hilar region not present before or after.

Her subsequent history was that of tuberculosis of the sacroiliac joint necessitating a cast for 18 months. In addition, she carried artificial pneumothorax on the left for six years. Today a small residual well-calcified lesion is seen in the left upper lobe apex. She is living a normal life with a full-time job.

This girl with a negative tuberculin test was found tuberculin positive when she developed her first infection with tuberculosis. Her minimal lesion progressed to far advanced in spite of eight months of bed rest. Her joint symptoms, her active sacroiliac disease and her pneumonic spread suggest a hematogenous phase of her tuberculosis.

Case II.

A.C.

PROGRESSIVE MINIMAL DISEASE IN AN INITIALLY POSITIVE REACTOR.

This 19 year old girl who was tuberculin positive on entrance with a negative chest plate developed a small 1.5 x 2 cm. lesion in the right mid-chest *two years* after admission to training. She was entirely symptom free without physical findings. Re-x-ray a month later showed what was thought to be a central highlight. But on re-examination four days later, it was no longer visible and at no time subsequently did it reappear. She remained at part-time work with extra rest. Regular monthly x-ray showed a recession in the size of this lesion, and general well-being.

However, in spite of her good progress, *13 months* after the first lesion was seen, there appeared on routine x-ray a new 5.5 x 2.5 lesion at the left apex. Once again it was entirely asymptomatic and without physical signs. She was hospitalized and given bed rest along with left artificial pneumothorax for eleven months. The latter was abandoned then as unsatisfactory after two pneumonolyses. An obliterative pleuritis followed. Her recovery was uneventful and today she is well, working full time with both lesions well calcified, married with one child.

She represents reactivation of tuberculosis in a *positive* reactor. She is probably very similar to the preceding case except for the long hiatus of well-being between the appearance of the first and second lesions on opposite sides, during which she remained on duty.

Case III.

M.C.

A HEALING MINIMAL LESION IN AN INITIALLY NEGATIVE REACTOR WHILE ON DUTY.

This 18 year old girl entered training in September, 1935, with a negative tuberculin test and a negative x-ray of the lungs. Because of a severe streptococcus throat two months after admission, she stopped training and was re-admitted in the next class five months later. At this time her tuberculin test was *strongly positive* to 0.001 mg. of old tuberculin. She showed on x-ray a homogenous density, 1 x 3 cm., in the periphery of the right first interspace. She refused treatment but was co-operative in her monthly check-up. No further sign of her lesion could be seen after five months, but in October, 1947, there is an irregular calcified deposit at the site of her early infiltration.

She is now well, married, with twins a year old.

This girl represents what must have been a first infection with tuberculosis in one whose resistance was good. Her pattern was parenchymal disease without demonstrable regional glandular enlargement.

Case IV.

E.W.P.

A HEALING MINIMAL LESION IN A COLORED GIRL INITIALLY TUBERCULIN POSITIVE WHILE ON DUTY.

This 19 year old colored girl came to training in September, 1942, with a positive tuberculin test and a negative x-ray. Eleven months after admission she developed, without symptoms, a ground-glass comet-like lesion 1 x 1.5 in the right third anterior interspace immediately below the interlobar septum, apparently in the right middle lobe.

Owing to the war and the shortage of beds in both sanatorium and hospital, she remained at work under close monthly clinical and x-ray supervision. In October, 1946, the lesion was smaller, retracted and fibrotic, showing, by 1948, small calcium deposits. She is well and working full time now.

There is no reason to suppose that this small asymptomatic lesion was other than a first infection similar to the preceding case, which became manifest by x-ray within the first year of entering training. This colored girl also showed extraordinarily good constitutional resistance. Hers was a small parenchymal lesion without demonstrable regional hilar gland enlargement.

Case V.

M.R.

ACUTE EXUDATIVE TUBERCULOUS LOBAR PNEUMONIA IN AN INITIALLY NEGATIVE REACTOR.

This 18 year old girl who entered training in September, 1935, remained tuberculin negative through May of 1936. September 5, 1936, she was ad-

mitted for minor urinary symptoms following a bad cold of a week's duration. She had had a stuffy nose and an unproductive cough, without fever.

Following admission to the hospital she rapidly developed high fever with pneumonic consolidation of the entire left upper lobe, over a ten day period. Her sputum became positive for acid-fast bacilli and her tuberculin test was positive for the first time. Transferred to a sanatorium she was given artificial pneumothorax, did well for about a year, then developed another pneumonic spread to the right side with cavitation. She died 18 months after the onset of her disease.

This acute pneumonic lesion appearing three months after a known *negative* tuberculin test must once again represent a first infection with tuberculosis in an individual of high sensitivity to the tubercle bacillus and low bodily resistance.

Case VI.

E.P.

ACUTE EXUDATIVE LOBULAR PNEUMONIA IN AN INITIALLY POSITIVE REACTOR.

This 18 year old girl admitted to training in 1938 was tuberculin *positive* with a negative x-ray and a normal physical examination. Fifteen months after admission, in December, 1939 she developed a pneumonic lesion in the upper third of the right lower lobe, with positive gastrics. Under sanatorium bed rest, she cavitated. She was given pneumothorax in February, 1940 but spread in March, 1941 to the left side. In September, 1941 she left the sanatorium against advice, married and did well at home for a year and a half maintaining her right pneumothorax. Then she returned in May, 1943 quite active, was collapsed on the left and re-expanded on the right. In February, 1947 the left pneumothorax was abandoned because of an obliterative pleuritis. Today she can be considered no more than quiescent and still treating.

There would seem to be very little difference between this and the preceding Case V. Both were acute pneumonic lesions varying only in the anatomical extent of lung involvement. The first, a pneumonic lesion in a girl tuberculin negative three months before; the latter a pneumonic lesion in one tuberculin positive since entrance. Neither presents any clinical or x-ray distinctions that would classify it a primary as opposed to a reinfection type of tuberculosis. They are both clinically apparently the same thing, a first infection, or more simply, progressive pulmonary tuberculosis.

Case VII.

J.F.

PLEURISY WITH EFFUSION IN AN INITIALLY NEGATIVE REACTOR.

This 19 year old girl was admitted to training in February, 1932. She had a negative chest x-ray and a negative tuberculin test which turned positive

six months after admission. February, 1933, one year after admission, routine x-ray revealed a small mottled infiltration one square centimeter in size in the lower segment of the right upper lobe with significant enlargement of the regional hilar lymph nodes. For two days she had had a small pleuritic pain in the right midaxilla without fever, cough or loss of weight. She was removed from training and sent home on 22 hours bed rest a day, which she is said to have observed for four months. Five months after the appearance of her parenchymal lesion on the right she had a bad head cold. Two weeks later she developed an acute febrile serofibrinous pleurisy with effusion on the right, for which she received eight months of sanatorium care. Shortly after discharge she was married against advice and had three children. Today she remains well and has brought up her whole family without further reactivation of her tuberculosis.

She was the first case of pleurisy that was shown to follow in the wake of a first or primary infection of the lung after conversion of her tuberculin test.

Case VIII.

H.K.

PLEURISY WITH EFFUSION IN AN INITIALLY POSITIVE REACTOR.

This 18 year old nurse was admitted to training in February, 1942, with a positive tuberculin test. In April, two months after entering training she had a small pleuritic-like pain in the left lower chest, with a negative x-ray. In May, three months after admission she had a similar but less marked pain in the right lower chest. In June, four months after admission she developed a small serous effusion of the right chest for which she took three months of sanatorium care, until October 30th. She returned directly to duty, obviously too soon, as she developed acute pleurisy with effusion on the left, together with enlargement of a left hilar gland. Seven more months of sanatorium care followed. Pneumothorax was accidentally established while tapping the chest. She is well today six years later and working full time without further reactivation.

ANATOMICAL NATURE OF THE TUBERCULOSIS.

The lesions with which we have had to work have for the most part been small pulmonary infiltrations 1 x 2 cm. in diameter with none larger than 6 x 8 cm. in the minimal group. They are classified in Table IV.

TABLE IV.
INITIAL CLASSIFICATION OF 70 PULMONARY LESIONS.

	<i>Total</i>		<i>Negatives</i>	<i>Positives</i>
	<i>No.</i>	<i>Per Cent</i>	<i>No.</i>	<i>No.</i>
Minimal	52	74.0	31	21
Mod. Advanced	9	13.0	2	7
Far Advanced	2	3.0	2	0
Pleurisy with Effusion	5	7.0	4	1
Unknown	2	3.0	1	1
	—	—	—	—
Total	70	100.0	40	30

No attempt is made here to distinguish between clinically significant tuberculosis and subclinical disease. The reason for this is that all early lesions are considered potentially progressive until proved otherwise. Therefore, the true picture of the pathogenesis of tuberculosis on a clinical basis, we believe, is best made without such a differentiation.

TREATMENT.

The treatment of nurses was fundamentally bed rest with definitive collapse procedures when indicated. No streptomycin was available for any cases. Table V shows the types of treatment in nurses, used throughout the study.

TABLE V.
TREATMENT OF 70 NURSES WITH TUBERCULOSIS.

	<i>Negatives (40)</i>		<i>Positives (30)</i>		<i>Total (70)</i>	
	<i>No.</i>	<i>Per Cent</i>	<i>No.</i>	<i>Per Cent</i>	<i>No.</i>	<i>Per Cent</i>
Sanatorium care	24	61.0	17	57.0	41	59.0
Home care	5	12.0	5	16.0	10	14.0
OPD supervision....	10	25.0	7	24.0	17	24.0
Details not known..	1	2.0	1	3.0	2	3.0
	—	—	—	—	—	—
Total	40	100.0	30	100.0	70	100.0

Bed rest, in both "sanatorium" care and "home" treatment included bathroom privileges except for the few who were cared for at the Boston City Hospital where *absolute* bed rest was imposed. For the minimal lesion, six weeks to fourteen months of bed rest was instituted for those who needed no collapse therapy. The

average period of bed rest was five and one half months in both the initially negative and positive tuberculin reactors for minimal lesion.

Four to eight months of slowly increasing exercise and privileges characterized the convalescence in the uncomplicated cases. "Out-Patient Department supervision" was a routine of regular monthly general physical, roentgen and laboratory examination. This group of nurses remained on duty, and with the co-operation of the training school, was permitted a mid-day rest with dietary additions, and was excused from night duty as long as was requested. These girls were indeed "treated" and were watched with the utmost care.

Table VI further elaborates the specific treatment procedures in the two groups of initially negative and positive reactors.

TABLE VI.
SPECIFIC TREATMENT IN 70 TUBERCULOUS NURSES.

	<i>Negatives (40)</i>		<i>Positives (30)</i>		<i>Total (70)</i>	
	<i>No.</i>	<i>Per Cent</i>	<i>No.</i>	<i>Per Cent</i>	<i>No.</i>	<i>Per Cent</i>
Bed rest only	22	55.0	10	33.0	32	45.0
Pneumothorax	8	20.0	10	33.0	18	26.0
Thorocoplasty	0	—	2	7.0	2	3.0
OPD supervision....	9	22.5	7	23.5	16	23.0
Unknown	1	2.5	1	3.5	2	3.0
Total	40	100.0	30	100.0	70	100.0

It should be made clear at this point that all early tuberculous lesions are potentially progressive and where symptoms of activity also accompany the visible x-ray infiltration, however small, there was no question of the need of bed rest treatment. A careful, scrupulous detailed history remains a great necessity in these cases. Too much emphasis may be placed upon the x-ray appearances alone. The physical examination of the lungs with these small lesions is almost always negative but the general physical examination may reveal defects that will bear an untoward effect on the progress of the infection. A monthly general examination, x-ray, laboratory study of blood, sedimentation rate, urine and weight, with a careful interval history leads usually to a valuable estimate of the tuberculous

lesion and of the patient as a whole. This type of individual study was the basis of our "Out-Patient Department supervision."

Pleurisy with Effusion.

There were in all 13 instances of pleurisy with effusion, as follows: 5 cases without any visible parenchymal lesion, 3 that followed the appearance of parenchymal disease by several months, 4 that were associated with minimal parenchymal infiltration after conversion of tuberculin and one which presented successive effusions on the right and then the left sides (Case VIII). Pleurisy with effusion has been demonstrated in this series to follow the primary infection after conversion of the tuberculin test to positive. Therefore it has been classed as a *reactivation* in every case where a parenchymal lesion was present or had been present.

Tables VII and VIII show the end results of the 71 cases of tuberculosis. Arrested tuberculosis includes also cases that are apparently healed. Unexpanded pneumothorax is classed as "still treating." *Reactivations* include asymptomatic x-ray-visible spreads and pleurisy with effusion as outlined above. "Reactivations" are classed only in those individuals who have been "arrested" and developed a new lesion at some subsequent date.

TABLE VII.
END RESULTS OF MINIMAL TUBERCULOSIS.

Minimal Tuberculosis (53)

A. End Results

	<i>Initially Negatives (31)</i>		<i>Initially Positives (22)</i>		<i>Total (53)</i>	
	<i>No.</i>	<i>Per Cent</i>	<i>No.</i>	<i>Per Cent</i>	<i>No.</i>	<i>Per Cent</i>
Finally arrested	27	87.0	18	82.0	45	85.0
Still treating	3	10.0	2	9.0	5	9.0
Dead	0	0.0	1	4.5	1	2.0
Unknown	1	3.0	1	4.5	2	4.0
Total	31	100.0	22	100.0	53	100.0

B. Reactivations

Infiltrates	6	19.3	7	31.8	13	24.5
Pleural effusions	4	12.9	3	13.6	7	13.2
Total	10	32.2	10	45.4	20	37.7

TABLE VIII.

END RESULTS OF MODERATE AND FAR ADVANCED AND
EXTRAPULMONARY TUBERCULOSIS AND PLEURISY
WITH EFFUSION.

<i>Mod. and Far Advanced (11)</i>	<i>Negative</i>	<i>Positive</i>	<i>Total</i>
Finally arrested	0	5	5
Still treating	2	2	4
Dead	2	0	2
<i>Extrapulmonary (1)</i>	1	0	1
<i>Unknown (1)</i>	0	1 (dead)	1
	—	—	—
Totals	5	8	13
<i>Pleurisy with Effusion (5)</i>			
(no infiltration of lung)			
Finally arrested	4	1	5
Reactivations	1	1	2
	—	—	—
Totals	4	1	5

Total Cases of Tables VII and VIII: Negatives 40, Positives 31, Total 71.

DISCUSSION.

This long term study of the pathogenesis of tuberculosis re-emphasizes the author's earlier observation on this series of nurses in 1941.⁷ There appeared then to be no distinguishing features in the clinical and x-ray characteristics of the tuberculosis that appeared in these nurses, whether they entered training as non-reactors or reactors to tuberculin. Distinction between so-called primary and reinfection tuberculosis was not apparent clinically at that time and the constitutional factor of resistance to tuberculosis appeared one of the most important features in the course and pattern of the infection.

The longer follow-up of this same group over five to fifteen years has emphasized the earlier conclusion that we are dealing with the same type of disease in both the initially negative and positive reactors. There has appeared over the years no distinguishing difference in either treatment or prognosis of the tuberculosis or its pathogenesis as seen in clinical and x-ray study. Amberson¹² has

pointed out that the distinction between "primary" and "reinfection" tuberculosis must be made on a pathological basis. There is every reason to believe, as these figures show, that all the tuberculosis in these young people is "primary" tuberculosis.

Ustvedt⁹ in reviewing Norwegian experience comes to these same conclusions; that clinically there is little difference between the reactions of children and adults, and "primary" and "reinfection" tuberculosis are clinically indistinguishable.

Probably the greatest contributors to this subject are Medlar¹⁰ and Terplan¹¹ in their exhaustive pathological studies of the pathogenesis of tuberculosis in humans.

Medlar¹⁰ has shown that there is no clear-cut pathological difference between "primary" and "reinfection" tuberculosis. He uses the term "reinfection" only in the sense that a previous infection has been entirely healed and the new "reinfection" behaves pathologically like the former "primary." In his pathological study of "Primary and Reinfection Tuberculosis as a Cause of Death,"¹⁰ he found that the "primary" or first infection was the usual cause of death from tuberculosis under the age of forty but was occasionally its cause up to sixty years. Beyond the age of forty "reinfection" tuberculosis was more common (the term reinfection being used again in the sense of new disease that has been acquired in the presence of a former but obsolete and healed "primary").

The influences that make "primary" or "first infection" tuberculosis in one individual go on to subclinical healing throughout its course, while another becomes progressive cavernous disease and still another shows early pneumonic consolidation with progression to a rapid death, are not clear. The clinical observations of this study point to the importance of inherent constitutional resistance as being one of the most important influences in establishing the course and prognosis of each case. All our nurses had the same theoretical exposure to sputum positive cases of tuberculosis during training with closely similar living and working conditions. It is of more than passing interest that the initially tuberculin negative and positive groups developed not only a closely similar amount of

tuberculosis but that the disease was alike in both groups as seen by similar treatment and similar end results.

It is of interest also that among the negative reactors on admission 14 per cent went through training without ever turning tuberculin positive. Perhaps these were endowed with a very superior resistance to tuberculosis which destroyed the tubercle bacillus before it could establish a "beach head" in the body. Perhaps they were just lucky. Eighty per cent of those who did turn positive showed no x-ray or clinical evidence of tuberculosis and exhibited the presence of acquired infection only by a positive tuberculin test. Fourteen per cent of those who did turn positive showed x-ray evidence of tuberculous lesions, with approximately one quarter of them sub-clinical throughout the course of their x-ray visible disease. These groups must all have been endowed with good resistance to their infection.

Amberson¹² believes too, that the constitutional factor of inherent resistance to tuberculosis or its absence, is probably most important in establishing the pattern of disease. But other factors of age, nutrition, fatigue, and physical and psychological response to work must also play their large part in the capacity of the individual to handle his tuberculosis.

The results emphasize that the tuberculin test remains the diagnostic standard for the presence or absence of tuberculous infection, but it is no criterion of differentiation between primary and reinfection tuberculosis. The tuberculin test on admission, whether positive or negative, did not appear influential in the type of tuberculosis that subsequently developed. The importance of x-ray survey on a six months basis for positive as well as initially negative reactors is well established where known contact to tuberculosis is high. Good mechanical technique for breaking contact and spread of tubercle bacilli should be established, but dependence upon these technical factors of prevention should not be exploited at the expense of other measures. No matter what mechanical or immunological procedures are used in prevention, constitutional resistance, general health, fatigability, diet and nutrition, the way of living

and psychological reactions to family, work and recreation, all play their part and contribute to the response of the host to infection. Can the student nurse be taught to live properly during the somewhat hazardous experience of nursing? Is the never ending pressure of work and studies with chronic fatigue a factor which we underestimate in the high incidence of disease in the student nurse and doctor?

It can be noted that in this experience with tuberculosis the nurses have done well over the years of observation. Whether this is due to their constitutional resistance, their urban origin, the early diagnoses of the small infiltrate, their initial reaction to tuberculin, their treatment, or the nature of their individual supervision and rehabilitation, it would be difficult to say. No one factor alone seems responsible, but all have contributed to a generally favorable late end result.

CONCLUSIONS.

1. A follow-up study of 745 nurses from 1932 to 1948 showed 9.5 per cent developing tuberculosis, 8.2 per cent of the positive reactors developing the disease, while 14.0 per cent of those who "converted" from negative to positive developed it. Eleven per cent of the initially negative reactors as a whole developed tuberculosis.

2. There were no clearly distinguishable differences in the types of tuberculosis, in its clinical course, its x-ray manifestations or its prognosis, as it appeared in the initially negative or positive reactor.

3. There appears to be no sound clinical basis for differentiating the tuberculosis that appeared in these young adults in the distinguishing terms of "primary" and "childhood type," or "reinfection" or "adult type" of disease.

4. A discussion of the clinical observations on the pathogenesis of tuberculosis is related to recent pathological studies which deviate from long accepted dogma concerning so-called "primary" and "reinfection" tuberculosis.

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Especially also, are we indebted to all the nurses of the study itself, without whose interest and response over the fifteen years the study would have been impossible. If there are any contributions to our knowledge of tuberculosis that have emerged from the analyses, we are indeed grateful to the 745 graduate nurses whose long records are the basis of this report.